SOME REMARKS ON THE CONNECTION OF METEOROLOGY WITH HEALTH.

By William Blasius.

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Sometime ago an architect asked me the question whether I could assign a philosophical reason for the well-known fact, that during all ages, cities, where topographical impediments do not interfere, extend as a general rule from east to west, and that the wealthiest people are always in the advance. As an instance of this kind, I will remind you of the West End in London, and of our fashionable Chestnut, Walnut, Spruce, and Pine Streets, which have grown steadily in this manner from the Delaware to the Schuylkill.

I had before paid some attention to this question under a somewhat different form, namely: What influence in reference to aerial currents has the position of a city or a dwelling house on the health of the inhabitants?

In speaking of a healthy or unhealthy location of a city or a house we hear frequently, in the reasoning on these points, the remarks made that it is on high or low ground, indicating thereby that a house is respectively healthy or unhealthy. This generally conceived impression has doubtless been derived from the idea that low ground must necessarily form a swamp, in which malarial gases are generated. Although this may be the case in many instances where no drainage exists and the ground is impervious to water, it is not always so; for the formation of a swamp depends more upon the geological formation than upon the altitude. I have seen swamps on mountains as well as on low ground, and houses close to a swamp on low ground perfectly healthy, while those standing on high ground and far off from a swamp were most unhealthy. The cause of malarial diseases must then be found in some other conditions, also.

Twenty or thirty years ago, when geology became more fully developed, medical men tried to find the cause of many diseases in the nature of the soil or in geological conditions, and I have no doubt that this has, indirectly, something to do with our health. A little later some diseases were traced directly to impure drinking-water. But it is only recently, that physicists began to suspect the air as the principal mischief maker. And if we consider that we eat only three times a day, drink water but twice as much, but drink or breathe air about fifteen times every minute, it becomes at least very probable that the air is the chief culprit that smuggles the poisonous matter into our system. For we inhale eighteen cubic feet of air every hour, or four hundred and thirty-two per day; and three-fourths of our weight has been built up of its material. This enormous consumption of air is performed almost unconsciously, at least without paying any attention to its quality, as we would naturally do in drinking-water. Because the air is invisible and tasteless the majority of people are scarcely aware of its existence, much less of its impurities

in certain localities, particularly in large cities. The most wonderful discoveries have been made in this direction by Ehrenberg, Schroeder, Pasteur, Dr. Smith, Schwann, Cohn, Dr. Bastian, Tyndall, Pettenkofer, and others.

Schroeder succeeded first in filtrating air by letting it pass through chemically pure cotton into a glass cylinder, from which the air had been exhausted by an air-pump.

The eminent French chemist, Pasteur, by using chemically pure gun cotton, which he, after the filtration, dissolved in ether, succeeded in collecting all impurities of the filtrated air, and subjecting the fluid to a microscopic investigation, he observed myriads of fungi and still smaller living organisms as Bacteria and Vibriones in it. He says: "It appears that our knowledge of contagious diseases, especially at periods when epidemics rage, would be increased by work carried out in this direction." Following his own suggestions, he was enabled to prescribe a means of preventing the disease known as "pébrine," which made such havoc amongst the silkworms in France.

Schwann showed that a fluid which produced myriads of such lower living organisms if left in contact with ordinary air, would keep free of them if first boiled and then brought in contact with air previously heated to redness; proving thus clearly that the germs of life came from the air. It also was proved that meat, fruit, etc., will preserve in pure air from one to two years and that fermentation and decomposition is carried on by the assistance of such minute organisms in the air. The conclusions, then, are not so far off from the truth that such minute parasites if in sufficient numbers, may, in entering on the wings of the air into our system, attack delicate or diseased organs, producing fevers, such as diphtheria, scarlet fever, etc. In the fall and spring, the times of sudden weather changes, we see an ordinary cold or catarrh in children change frequently into diphtheria, or other similar diseases.

Blackley considers he has proved that hay fever is caused by the inhalation of air containing pollen in considerable quantity, which adheres to the membranous lining of the larynx and air-passage and causes secretion from these parts. A solution of quinine, which is destructive to minute forms of life, has been shown by Helmholtz to be an effective application in cases of this disagreeable malady.

Tyndall, in 1870, gave us a means of investigation supplementary to the microscope, and of extreme delicacy. He proved that particles, which in a liquid are quite invisible under an object glass readily showing bodies of $\frac{1}{100,000}$ of an inch in diameter, were revealed with greatest ease by means of a beam of light. If the air were pure, a beam of sunlight traversing a darkened room would be invisible except where it struck upon the wall. The scattering of the light by floating dust and living organisms makes the track luminous to the naked eye. We may, to a certain extent, see these impurities dancing in a beam of light which enters through the shutters into a darkened room.

Dr. Smith made an experiment with a bottle holding five litres, which was refilled five hundred times with Manchester air. Dancer in examining this quality of air with magnifying powers from 120 to 1,600 diameters of an inch found the following bodies:

1. Particles of vegetable tissue, many of them partially burnt and quite brown in color.
2. Fragments of vegetation resembling in structure hay, straw and hay seeds.
3. Hairs of plants and fibres resembling flax.
4. Cotton fibres both white and colored.
5. Starch granules.
6. Wool white and colored.
7. In greatest abundance fungoid matter, spores and sporidia varying in size from $\frac{1}{10,000}$ to $\frac{1}{30,000}$ of an inch in diameter.

Many of the spores were living and developed forms resembling rust and mildew. A calculation was made as to their number in the following manner:

Under each field of the microscope there were more than one hundred spores. In each drop of liquid there were over 250,000; the whole quantity consisting of one hundred and fifty drops there were in this water no fewer than $37\frac{1}{2}$ millions of spores visible. This quantity of air is the amount respired by an average sized man actively employed during ten hours in Manchester.

There is then hope that science soon will trace the source of many if not all of those mysterious deadly diseases and epidemics, and in finding their source, the remedy and preventive will be furnished at the same time. So much, however, is now already known that those destructive minute organisms in company with the well-known poisonous and noxious gases, originate principally in localities where vegetable and animal matter are decomposing; in thickly populated cities, on and underneath the pavement, gutters, yards,—in swamps and rivers into which sewers throw their contents. Here the air must become, so to say, saturated with these deadly poisons. We, therefore, understand that thoughtful people abhor such places, and flee away from them. But as the air loaded with these deadly poisons, does not stay where it generates, nor flow promiscuously in all directions, it becomes of some importance to know where we have to go, so as not to meet it; and here comes the youngest of the physical sciences, Meteorology to our assistance. In a lecture which I had the honor of delivering before you some two years ago, I showed that air in its motion follows strict laws the same as water, and that the direction and nature of its currents are dependent upon the season, the configuration and nature of the surface of the earth. According to these laws we experience in our latitude during Summer a prevailing current from the southern semi-circle principally from the southwest, south or west; in the Winter a prevailing current from the northern semi-circle, principally from northwest and north. Air of the same temperature or currents flowing in

the same direction do not mix much. Thus an offensive air-current coming from the opening of a large culvert would be perceived over a distance of 5 to 6 blocks, but only in space corresponding in width and depth to the opening from whence it issues. As the development of organized life, as well as of other noxious elements, in the air takes place principally during the warm season, when the prevailing wind in our latitude comes from the southwest, it follows that a house or a city to the north, northeast, or east of a source of such disease-brewing miasmas cannot be healthy, whether they lie high or low, or even if they are far off from this source; but if they are situated to the south, southwest or west, of such a hot-bed of miasma, they will not suffer from such localities, even if it is close by and on low ground. As the miasma carrying southern current is warm and rises over the highest mountains, it certainly will reach a house or a city lying 10 or 100 feet higher than a swamp. I know houses close to a swamp or river, those southwest of them are perfectly healthy, while those much further off, higher and to the northeast of them are uninhabitable on account of malarial fever. Illustrations of this apparent anomaly are frequent. Along low swampy rivers in summer you will find the eastern shore unhealthy, while the western shore is healthy. To bring matters home to us, I would say that West Philadelphia generally, even the Almshouse and Pennsylvania University, so close to the swamps of the Schuylkill, enjoy, during the dangerous warm season, the purified air from agricultural Delaware county, while the fashionable residences along the eastern shore of the Schuylkill are most exposed to the miasmatic air from the Schuylkill, into which the sewers throw their contents, from the swamps along its western shore, and from the lower portion of the city. Camden, situated to the east of two such rivers, with their swamps, and an artificial swamp between them, this city has still more to suffer. A friend wishing to buy a house upon the western slope of Brooklyn Heights was advised by physicians to choose rather the eastern side; since upon the western slope, even at the summit, malarial fevers are more numerous and more virulent. The reason for this is obviously that the wind which brings the miasma from the river and the low lands to the west and southwest is a warm one, and thus reaches the highest point west of Brooklyn Heights, but *passes high above* the lower land to the east. As little as any of us would like to drink the water of a river in which decomposition from vegetable and animal matter is going on, so little would we like to drink out of an air current saturated much more with poisonous gases and destructive organisms, if our eyes and tongue were sensible of it. This is the reason why a house in the western portion of a city is more healthy than one in the eastern or northern portions, and why cities extend to the west, not to the north, except where impediments determine their direction; in this case those living most to the north will have to pay the penalty in the rate of death. This is also the reason why in a well regulated city no noxious factories should be allowed on its western or southern side, such as the limekiln above

Chestnut street, the gas works above Market street, cemeteries, etc. Any one who wants practical illustrations of the different effects of the same air current on the western and eastern side of the Schuylkill, may pay attention to his breathing before and after passing the Chestnut street bridge. It is also a reason why the streets of a city should run from southwest to northeast, and from northwest to southeast, in order that during the warm season the prevailing currents could ventilate them and change the poisonous air which generates in the streets and yards. It is probably the reason why in cities certain diseases become epidemic as it enlarges, which before are comparatively unknown.

How the direction and nature of prevailing air currents affect the health of cities can be seen by comparing the rate of death in two successive years, of which one brings quite a tropical, the other a more arctic climate, during summer. This would seem to be due fully as much to miasma as to the direct effects of the heat on the system.

The *Public Ledger* of July 14, 1874, had an article comparing the health of Philadelphia for the period June 15th to July 15th, of the years 1872, 1873 and 1874, in which the writer seems to ascribe the improvement manifested to better arrangements in city government. This of course would have its effect, but the difference seems to me unquestionably due in large part to the difference in the prevailing air-currents.

From the data the *Ledger* article furnishes, I have compiled the following comparison of mortality in the principal diseases, which is very striking in view of the fact that in June and July of 1872, the prevailing currents were from the southern semi-circle, and in the same time of 1874, from the northern semi-circle :

	1872. EQUATORIAL CURRENT.	1874. POLAR CURRENT.
Adults	135	51
Minors	1118	301
Cholera infantum	713	111
Marasmus	96	56
Debility in Infants	84	38
Convulsions	96	49
Cholera morbus	31	1

I have compared 1872 and 1874, because the contrast is strikingly marked ; the mortality during the same weeks of 1873 was about midway between, in conformity with the air-currents.

The whole subject is of the greatest interest and the utmost importance ; and the field of inquiry a very wide one, promising the most satisfactory results.

I have given these few suggestions merely to call attention to the subject.

Discussion.

Mr. Walter remarked that he considered the imperfect construction of sewers, cess-pools and traps connected with sinks and water-closets as the great source of many of our worst diseases. We have, it is true, a very general under-ground drainage throughout our city, but that is not all we need; our sewers and ducts may all be well enough, as far as they go, but unless it is rendered absolutely impossible for the foul air they contain being forced back, through imperfect traps, into our dwellings, we had better have no underground drainage at all.

Carelessly-jointed pipes, inferior fittings, badly-constructed traps, and unventilated soil pipes cannot fail to admit the sewer gas into our houses, which becomes a prolific source of disease and death. Pipes which drain bath-tubs and washstands are often introduced into soil pipes without trapping, and thus become conduits to convey the worst of sewer gases into our chambers; and even when such pipes *are* trapped the work is so unskillfully done as to render the traps liable to be siphoned out by descending water from above. He stated that he had a case of this kind to happen in a house of his own, where the plumbing was admirably done—it was an oversight, soon corrected, but there should be no oversights in the plumbing of a house. Nothing about house-building demands our consideration more seriously than the work of the plumber.

Another evil exists in the imperfect construction of sewers, and a want of skill in their design and location. Many sewers discharged into tide-water with their openings so much depressed as to bring the top below high tide; this causes a flow when the tide is up, which forces the air back through traps and cess-pools with great power, and if sufficient vent is not found the sewer will rupture in its weakest spot. He remarked that he knew of a case of this kind, where the water and filth were forced several feet above the pavement—nothing will make a sewer so located safe, but an ample ventilating shaft, properly constructed.

Besides these sources of disease and discomfort there are others, many of which were alluded to in the interesting paper just read to the Society by Dr. Blazius. This subject may well engage the most careful study of the scientist.

Dr. Horn said:

While there are atmospheric influences affecting the health of the masses generally, in cities, which are at times troublesome or next to impossible to obviate, there are causes within the dwellings of our population no less potent, and which are entirely within our control.

It has been noticed by many not members of the medical profession that typhoid fever, scarlatina and diphtheria prevail with great frequency among the better classes of our population (especially typhoid fever); and to such an extent has this prevailed that scarcely a family is found in

which no one of the members has been affected, while in many several cases have occurred. This prevalence may be thought all the more remarkable when we consider the great external and internal cleanliness of the houses of our better classes of citizens.

There can be but little doubt that our house-drainage has contributed more to the detriment of the health of the above-mentioned citizens than those causes which are generally complained of. Owing to faulty construction of the drain-pipes, sewer gases find ready entrance into our houses and in certain directions of the wind and during a high tide these gases are driven backward from the mouths of the main sewers, and the offensive odors are perceived in the rooms in which are water-closets or stationary washstands. These gases force themselves through the usual traps because *there is no other means usually provided for their exit.*

Every house provided with a system of *under-drainage* should have a draft-pipe of *large* size leading from the drain upward, in a straight line above the roof of the house and open at the top so that a free draft may be allowed. Into this all water-closets or other waste-pipes should enter at a *right angle*, after a proper trap, and no waste-pipe should empty into any conductor unless the latter extend above the roof and be open at the top. Any attempt at obviating the evil, such as small draft-pipes from each water-closet to a chimney, etc., has been proven practically to be of no value.

The fault in the construction of the water-closets consists in placing that of the upper story, practically on the end of the main conducting pipe, and it is for this reason that it has been noticed that water-closets which are highest in the house are most offensive. Thus no external draft for gases is allowed for, and their entire volume must be discharged in the house, greatly to the detriment of the health of the inhabitants. The remedy suggested is easy of accomplishment, cheap, and effectual.

The ordinary methods of warming our houses by means of heaters of varying construction in the cellars, have without doubt some effect on those who breathe the air sent through the house *from the cellar*. Cellars are not usually the cleanest portions of dwellings, and are too often left to the care of servants, to become the respositories of rubbish, and at times filth, which accummulate, and the usual dampness of cellars together with the even temperature maintained are favorable to slow putrefactive processes, which yield germs by no means harmless. There can be but one remedy for this evil. All air to be distributed in a heated form should be drawn from the external atmosphere, and as hot air is distributed by means of pipes so also can pure air be obtained from the outside and taken directly to the hot chamber of the heater.

These remarks are necessarily short, but will, I hope, serve to call the attention of architects, and builders to at least two very serious defects in the "better class" of houses.